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EFFECT OF POLYPROPYLENE FIBER ON MECHANICAL PROPERTIES OF CONCRETE CONTAINING FLY ASH

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ABSTRACT

Concrete is one of the best comprehensively required materials in the advancement business as a result of its adaptability and low upkeep cost during organization life. In sustained strong, solid gives an ideal area to verifying the embedded steel fortress and fundamentally manages compressive weights however the steel bolster gives the important flexibility. Advancement of split tensile strength in the strong structure at usefulness conditions is one of the difficult issues which reduces the nature of bond and prompts disillusionment of the structure quite a while before the typical presence of a structure. In the present work a preliminary report has been coordinated to investigate the effect of polypropylene fiber on mechanical properties of fiber reinforced bond. Five particular fiber volume parts (0.5%, 1%, 1.5%, 2% and 2.5%) were used. The presentation of fiber invigorated concrete containing fly flotsam and jetsam was surveyed by choosing compressive quality, flexural quality and split flexibility at 7 years of age and 14 days. The results show that at both 7 and 14 days, the most significant compressive quality, flexural quality and spilt flexibility was accomplished by the development of 1.5% of polypropylene fibers.

KEYWORDS: Fly Ash, Polypropylene Fibers, Compressive Strength, Split Tensile Strength & Flexural Strength

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Original Article

1. INTRODUCTION

Fly debris displays pozzolanic properties which have prompted its utilization as a constituent of cement. A pozzolana is characterized' as "a siliceous or siliceous and aluminous material which in itself has almost no cementitious worth however which will, in finely partitioned structure and within the sight of dampness, artificially respond with calcium hydroxide at standard temperature to frame mixes having cementitious properties" [1]. Fly debris causes ecological contamination as well as its stockpiling cost is high. The utilization of fly debris in solid offers a comprehensive methodology which can assist us with achieving the objectives of gathering the rising requests for improvement of solid solidness and biological transfer of enormous amounts of strong waste items from coal-terminated power plant [1, 2, 3] and furthermore utilization of fly debris in cement blends influences all the part of solid properties. The consideration of fly debris in solid impacts the rheological properties of the plastic cement, the quality, porosity, and sturdiness of the solidified mass, and the expense and vitality expended in assembling the last item [1].

Cement is increasingly inclined to early age breaking brought about by shrinkage because of the utilization of mineral admixtures. Short strands have been utilized to strengthen the fragile materials like bond and cement [2]. Filaments as a rule and polypropylene strands specifically have expanded notoriety as of late for use in cement. Polypropylene filaments are synthetically inactive and entirely stable in the antacid condition of cement.

They have a moderately high softening point with minimal effort crude materials. They have hydrophobic surface with the goal that it doesn't assimilate water. Its installation in the solid lattice gives a defensive spread, limiting affectability to fire and other ecological impacts [4]. Polypropylene strands moderate plastic and early drying shrinkage by expanding elasticity of cement and spanning the shaping breaks [5]. The incorporation of polypropylene fiber in solid blend limits the fragility of the network and thus lessens the vulnerability to splitting of a solid [6]. Polypropylene fiber was likewise compelling in opposing the improvement of breaks brought about by drying shrinkage [7, 8].

Different analysts have explored various properties of cement with fly debris and expansion of polypropylene fiber. Alhozaimy et al. [9] has led a thorough exploratory investigation and factual examination, on the impacts of low volume divisions of grouped fibrillated polypropylene filaments on the compressive and flexural quality and sturdiness, and effect opposition of polypropylene fiber strengthened solid materials. From measurable examination the creators saw that the polypropylene strands have no factually critical consequences for compressive or flexural quality of cement, though flexural strength and effect opposition demonstrated an expansion within the sight of polypropylene filaments. Positive connections were likewise recognized among strands and pozzolans. Qiana et al. [10] have explore the enhancement of fiber size, fiber substance, and fly debris content in half and half polypropylene-steel fiber concrete with low fiber substance dependent on general mechanical properties. Monofilament sort of polypropylene fiber and three sorts steel filaments were received in the examination. From the outcomes the creators found that various sizes of steel strands added to various mechanical properties, at any rate to an alternate degree. It was additionally seen that; the option of little fiber type impacted the compressive quality yet the parting rigidity was influenced marginally. A huge fiber type offered ascend to inverse mechanical impacts, which were additionally invigorated by enhancement of the viewpoint proportion. Sivakumar et al. [11] have assessed the mechanical properties to be specific compressive quality, split elasticity, flexural quality and flexural sturdiness of different fiber fortified solid frameworks, containing individual steel strands and mixture blends of steel and non-metallic filaments, for example, glass, polyester and polypropylene. The absolute dose of filaments was kept up at 0.5%. From the outcomes the creators found that among all the half and half fiber mixes, just the steel polypropylene fiber blend (with 0.12% polypropylene filaments) performed better in all regards contrasted with the mono-steel fiber concrete. It was seen that flexural strength was diminished with the expansion in extent of non-metallic strands. Bilodeau et al. decided the ideal measure of polypropylene strands to be utilized in the light weight cement to avoid spalling when it is presented to hydrocarbon fire, mulling over the qualities of the lightweight total, the water-to-bond proportion (w/c) of the blends, and the length and thickness of the filaments. From the investigation it is accounted for that near 3.5 kg of the 20-mm polypropylene strands per cubic meter of cement is important to forestall the spalling of a low w/c lightweight cement made with silica smolder mixed concrete when exposed to hydrocarbon fire. It is additionally revealed that the measure of 20-mm filaments to forestall spalling for a higher w/c of 0.42 is altogether less. Xiao and Falkner [12] have researched the conduct of elite cement (HPC) with and without polypropylene strands at raised temperatures. The creators have uncovered the examples of HPC to temperature extending from 20oC to 900oC. It is seen that, no dangerous spalling in example made of HPC with polypropylene filaments, while some spalling happened in examples made HPC without polypropylene strands during fire test. Further it is seen that with and without the expansion of polypropylene filaments the lingering compressive quality and leftover flexural quality of HPC drops consistently under rising temperatures. It is discovered that the impact heater slag is advantageous to the lingering compressive and flexural qualities of HPCs with and without polypropylene filaments after fire introduction, contrasted with silica rage. From the audit of the writing it is seen that work on cement containing fly debris with changing measurements of polypropylene

strands is sparse. Along these lines in the present research work an endeavor has been made to examine the impact of monofilament polypropylene fiber on conduct of cement containing fly debris.

2. EXPLORATORY PROGRAM

The exploratory program has been intended to assess the impact of monofilament polypropylene fiber on conduct of cement containing fly debris by supplanting various rates of polypropylene fiber by various fiber volume divisions.

2.1 Materials Used

Conventional Portland bond and class F fly debris were utilized in the present work. The synthetic synthesis of standard Portland concrete and fly debris utilized in the present examination is appeared in Table 1. Conventional Portland bond (OPC) of 53 evaluation fulfilling IS: 12269-1987 [13] and fly debris was utilized as 20% substitution by weight of common Portland bond was utilized in setting up the solid examples. The polypropylene fiber utilized in this examination is monofilament polypropylene fiber. Polypropylene fiber was utilized as 0.5%, 1%, 1.5%, 2% and 2.5% by volume division of folio content. A cementitious material substance of 426 kg/m3 was utilized in all solid blends. Fine total (sand) with explicit gravity of 2.6 and fitting in with evaluating zone II according to Seems to be: 383-1970 [14], was utilized in the arrangement of solid examples. Coarse totals of size 10 mm MSA were utilized. The deliberate estimations of explicit gravity of 10 mm MSA was 2.63. Faucet water from research center was utilized as blending water in the readiness of cement blends. Water substance of 191.6 Kg/m3 was utilized in the solid blends for a droop of 40 mm. The solid examples were made with water to cover proportion (w/b proportion) of 0.45. The subtleties of the solid blends utilized in this examination are displayed in Table 2.

Table 1: Chemical Compositions of Ordinary Portland Cement and Fly Ash

Constituent (wt. %)	Ordinary Portland Cement	FLY ASH
Silicon dioxide	23.46	62.2
Aluminum oxide	5.05	25.3
Ferric oxide	3.4	0.13
Calcium oxide	59.76	16.6
Magnesium oxide	3.31	1.15
Sulphur trioxide	1.42	0.2
potassium oxide	0.54	0.4
Sodium oxide	0.3	0.13

Table 2: Details of Concrete Mixtures

Water-cement ratio	0.45
Water content (kg/m^3)	191.6
Cement content (kg/m^3)	426
Fine aggregate (kg/m^3)	598
Coarse aggregate (kg/m^3)	1136

2.2 Specimen Preparation

Solid 3D shapes examples of 150 mm x 150 mm x 150 mm size, solid shaft examples of 100 mm x 100 mm x 600 mm size and solid chambers with 300 mm tallness and 150 mm in measurement were casted to assess the variety in compressive quality, flexural quality and split rigidity individually. In the wake of throwing, every one of the examples were kept in the molds for 24 hours. The examples were then demolded and damp restored in a relieving tank till the ages of 7 days and 14 days.

2.3 Test Procedures

2.3.1 Compressive Strength Test

The compressive quality test was led on 3D shape examples at the periods of 7days and 14 days in a pressure testing machine. For each solid blend containing distinctive volume portions of polypropylene strands, three 3D squares were tried and the normal estimation of compressive quality was resolved.

2.3.2 Flexural Strength Test

The flexural quality test was directed on bar examples at the ages of 7 and 14 days as per IS: 9399-1979 [15]. Flexural quality is communicated as far as modulus of crack, which is the most extreme worry at the extraordinary strands in twisting. The Three-Point twisting test is led on a stacking edge to decide the flexural quality of solid shafts. The shaft example is just upheld on two rollers isolated 600 mm separated at the base. The shear range isolating the stacking focuses from the backings was equivalent on the two parts of the bargains making a zero-shear locale between the two stacking focuses. The heap was applied bit by bit without stun expanding constantly. The heap is isolated similarly between two roller focuses and is expanded until the example falls flat. The schematic graph of bar arrangement is appeared in Figure 1. For each solid blend containing diverse volume parts of polypropylene strands, three crystals were tried and the normal estimation of flexural quality was resolved.

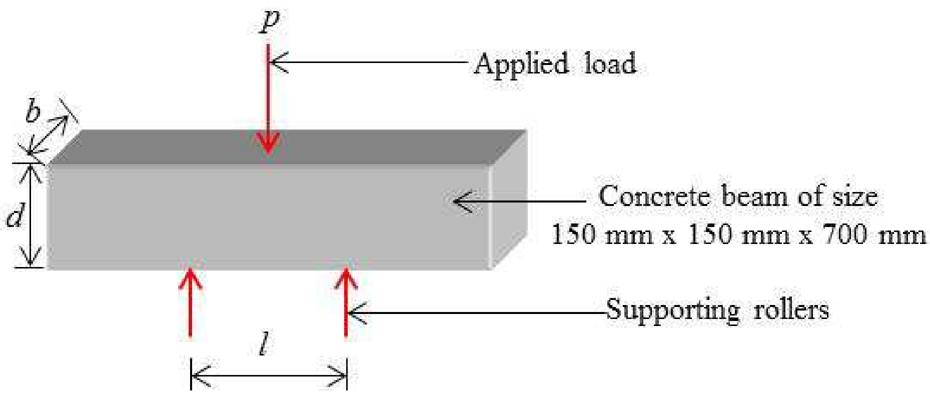

Figure 1: Schematic Diagram of Beam Setup for Flexural Test.

Modulus of rupture was calculated for the maximum load taken by the member as:

Modulus of rupture,

$$f_b = \frac{pl}{bd^2} \text{ for } a > 133 \text{ mm}$$

$$f_b = \frac{3pa}{bd^2} \text{ for } a < 133 \text{ mm}$$

where P is the greatest burden applied to the example (Kg), l is the range on which the example is upheld (cm), b is the deliberate width of example (cm), d is the deliberate profundity of example (cm), an is the separation between the line of break and the closer help estimated on the inside line of the pressure side of example (cm).

2.3.3 Split Tensile Strength Test

Parting elasticity was resolved as per IS: 5816-1999 [16] at the ages of 7 days and 14 days. This is an aberrant test to decide the elasticity of the round and hollow examples of size 150 mm distance across and 300 mm tallness. The test was

completed by putting a round and hollow example on a level plane between the stacking surface of a pressure testing machine and the heap was applied until the disappointment of the chamber, along the vertical width. So as to decrease the extent of the high compressive quality close to the point of stacking, tight pressing of pressed wood was put between the example and the stacking plates of the machine. The rigidity on chambers is determined by $2P/\pi dl$.

Where, P is the most extreme burden applied to the example (Kg), l is the range on which the example is bolstered (cm) and d is the disappointment point profundity of example (cm).

3. EXPERIMENTAL RESULTS AND DISCUSSION

3.1 Effect of Fiber Volume Fraction on Compressive Strength of Concrete

The normal compressive quality estimations of the distinctive cement blends produced using conventional Portland bond supplanted with 30% of fly debris and with the expansion of various rates of polypropylene strands are appeared in Figure 2. The variety in compressive quality of cement with various rates of polypropylene strands at various ages in comparison to control solid examples is appeared in Figure 3.

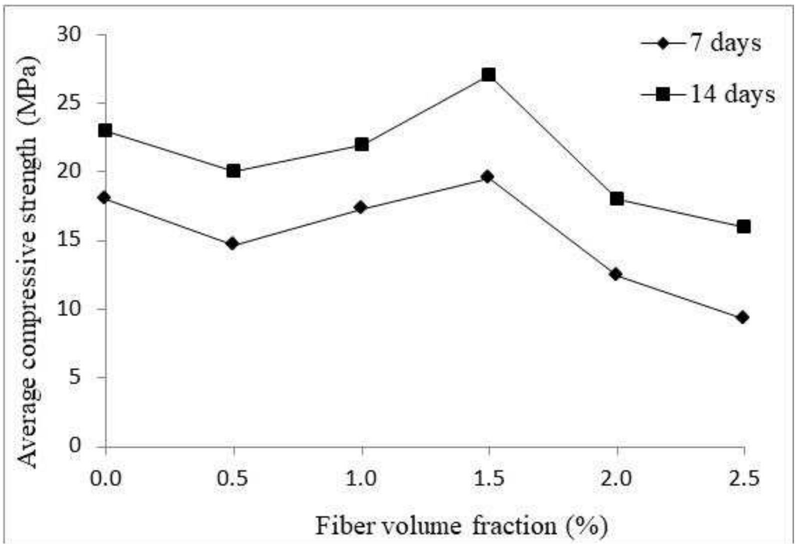

Figure 2: Average Compressive Strength of Concrete Mix with different Percentages of Polypropylene Fibers at different Ages.

From Figure 2 it is seen that the most extreme compressive quality of cement is accomplished at 1.5% fiber volume division and diminished with increment in level of fiber at the two ages for example 7 and 14 days. The expansion in the compressive quality of cement at 1.5% volume part of strands is credited to the pore crossing over ability of filaments. The lessening in quality of cement because of increment in fiber rate is verified to the imperfections during the planning of concrete, because of which the ideal pressing of cement and strands can't be accomplished.

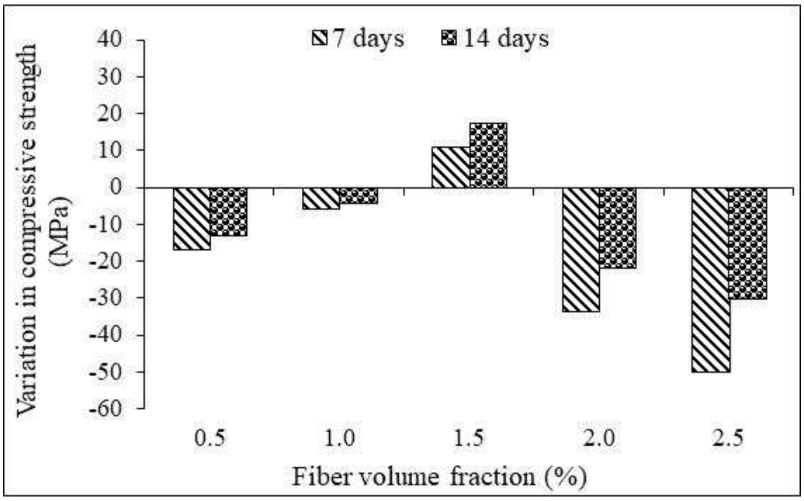

Figure 3: Variation in Compressive Strength of Concrete with different Percentages of Polypropylene Fibres different ages w. r. t Control Concrete Specimens.

3.2 Effect of Fiber Volume Fraction on Flexural Strength of Concrete

The normal flexural quality estimations of the distinctive cement blends produced using customary Portland concrete supplanted with 30% of fly debris and with the expansion of various rates of polypropylene strands are appeared in Figure 4.

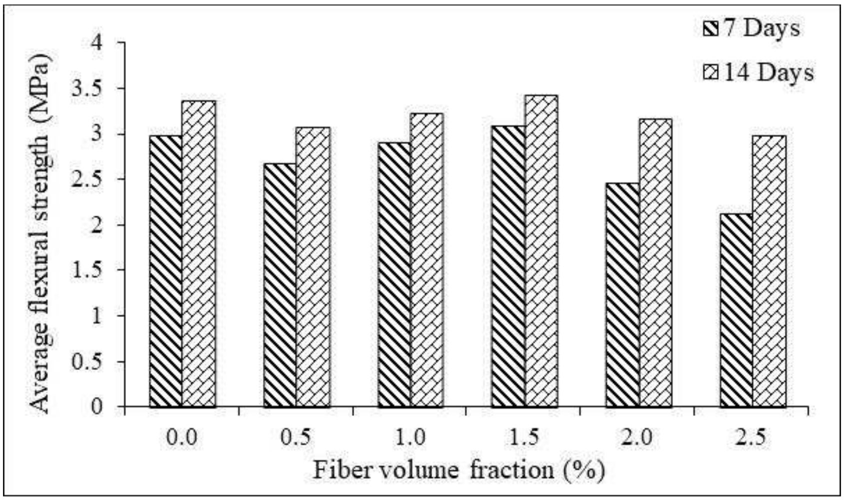

Figure 4: Average Flexural Strength of Concrete Mix with different Percentages of Polypropylene Fibres at different Ages.

From Figure 4 it is seen that the most elevated flexural quality of cement is accomplished by the expansion of 1.5% fiber volume division and after that diminished with increment in level of fiber at the two ages for example 7 and 14 days. The expansion in the flexural quality of cement at 1.5% volume division of filaments might be because of the nearby dispersing of strands which encourages the filaments to work proficiently as split arrestor by connecting the pores.

3.3 Effect of Fiber Volume Fraction on Split Tensile Strength of Concrete

The normal split elasticity estimations of the distinctive cement blends produced using customary Portland concrete supplanted with 30% of fly debris and with the expansion of various rates of polypropylene filaments are appeared in Figure 5.

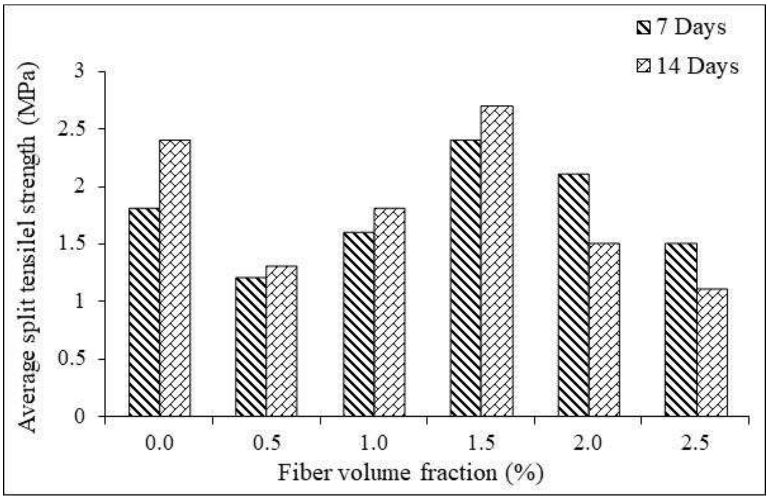

Figure 5: Average Split Tensile Strength of Concrete Mix with different Percentages of Polypropylene Fibres at different Ages.

From Figure 5 it is seen that the best improvement of split elasticity of cement is accomplished by the expansion of 1.5% fiber volume division and afterward diminished with increment in level of fiber at the two ages for example 7 and 14 days. The expansion in the split elasticity of cement at 1.5% volume portion of filaments is credited to the high surface territory of strands which leads to the upgrade of solidarity among fiber and lattice.

4. CONCLUSIONS

The present examination is led to explore the impact of polypropylene fiber on mechanical properties of cement containing fly debris. From the outcomes, it is discovered that the expansion of filaments increments the compressive quality, flexural quality and split elasticity at 1.5 % volume division strands. Be that as it may, the higher substance of strands has unfavorable impact on compressive quality, flexural quality and split elasticity of solid, this might be because of deformities during the arrangement of concrete, because of which the ideal pressing of cement and filaments can't be accomplished at higher substance of strands. In this manner the ideal volume part of polypropylene strands to be included cement was found as 1.5%.

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